Building a Butternut Kitchen

Hand-planed hardwoods and high-grade plywood coupled with dowels and dovetails

by Rex Alexander

"Wood is vulnerable; it can be spoiled by a single wrong movement of the tool. It has its textures, luster, rhythms—but only the patient hand and seeing eye can coax these forth. Never inert, wood has a will of its own, the seasonal breathing of which can split rock and burst walls." —James Krenov, in *A Cabinetmaker's Notebook*.

When I first read *A Cabinetmaker's Notebook,* I was deeply inspired by James Krenov's words of wisdom, not to mention his refined woodworking techniques. Since then, I've studied all of Krenov's books (he's written four that I know of), tried out his methods and gone about my work with an enhanced regard for wood.

The turning point in my career as a cabinetmaker came when Glen and Dottie Williams asked me to design and build kitchen cabinets for their new house. The house, designed by Texas architect Kenneth Loose, sits atop a bluff near Traverse City, Michigan, overlooking East Bay. The kitchen occupies the west side of the main floor, two steps above a living room that offers dramatic views of the bay.

I knew immediately that the upper cabinets between the kitchen and living room would need glass-panel doors on both sides to link the kitchen visually to the living room. I also thought the cabinets should be simply styled so as to not detract from the open plan and spectacular views, yet at the same time should quietly display wood and craftsmanship.

In short, here was my chance to apply a dose of Krenovian perspective (at least as I interpret it) to a kitchen-cabinet job. That meant carefully selecting wood for color and figure, doweling carcases, dovetailing drawers and doing plenty of hand-planing (one of my favorite pastimes).

The basic plan—The Williams wanted their cabinets to be made of butternut (sometimes called "white walnut"). Once revered by cabinetmakers, it's a lightweight and moderately soft native North American hardwood (you can dent it easily with a fingernail) that's endowed with rich, chestnut or ginger-brown coloration and delicate figure.

I decided to fuse the subtle beauty of butternut on the outside of the cabinets with the structural integrity of plywood on the inside (photo below). The base carcases (drawing facing page) would consist of ¾-in., A-2 ("A" grade on both sides) birch plywood tops, bottoms and sides tongue-and-grooved together, backed with ¼-in. birch plywood and fitted with butternut-edged, plastic-laminate countertops. Visible ends of the cabinets would be fitted with solid quartersawn butternut panels instead of plywood, and the bottoms of the cases would be embellished with beveled butternut molding and butternut toe kicks.

The design of the upper cabinets was inspired by a delicate pearwood cabinet featured in one of Krenov's books. Typical of his work, that cabinet has solid-wood tops and bottoms doweled to solid-wood sides. Because butternut is so soft, I decided to dowel solid

Inspired by the work of furnituremaker James Krenov, the kitchen cabinets combine the subtle beauty of hand-planed butternut with the structural integrity of plywood.

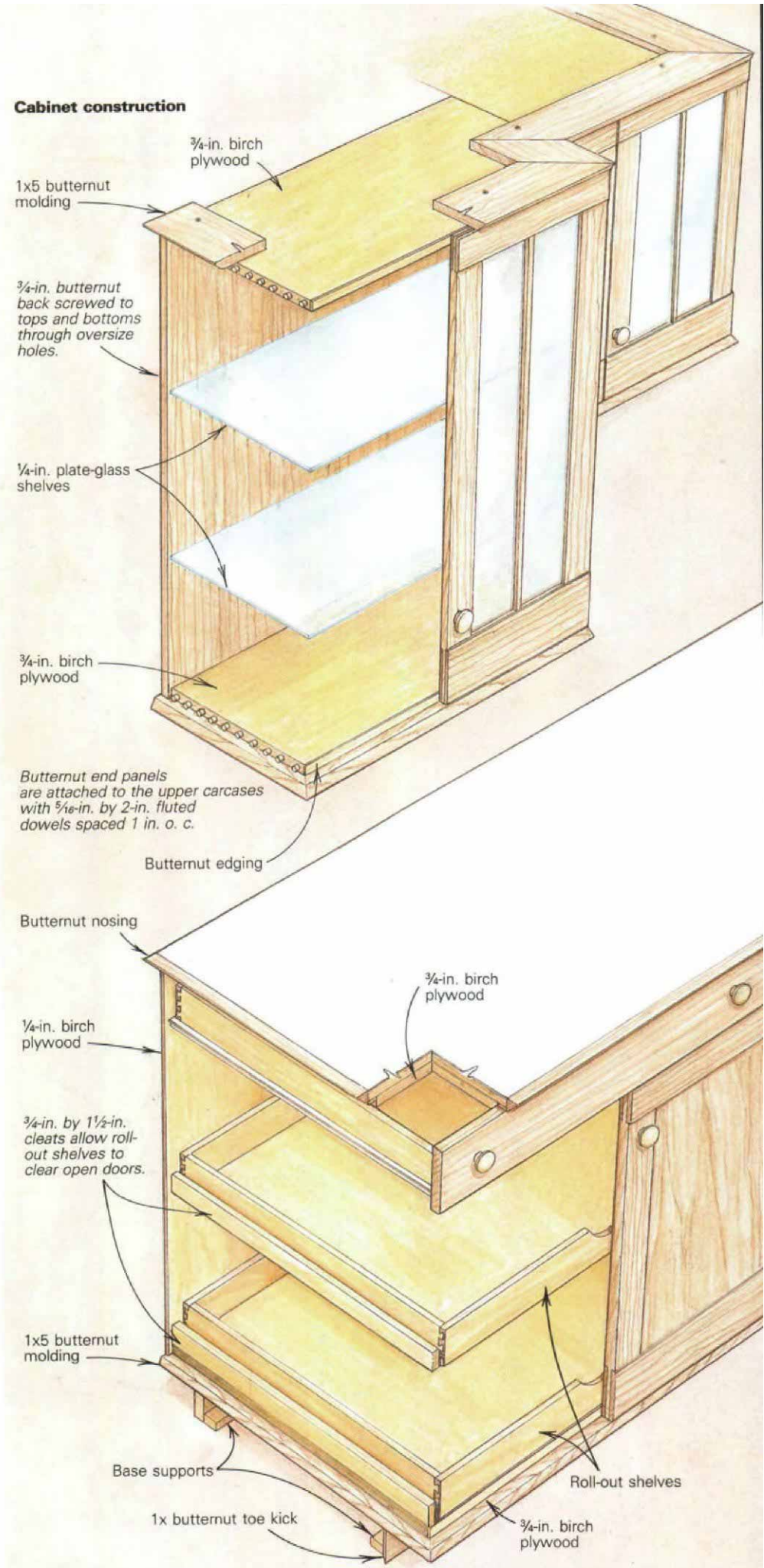
butternut sides to birch plywood tops and bottoms. That way, the plywood, and not the soft butternut, would absorb any wear caused by the daily jostling of cookware and dishes.

In theory, doweling solid wood to plywood in this way can cause problems because solid wood tends to shrink and swell across the grain in response to humidity changes, while plywood is relatively stable. But because butternut is one of the most dimensionally stable domestic hardwoods and these cabinets would be finished inside and out for moisture resistance, I figured there would be no risk in joining the two materials (for more on wood movement, see the sidebar on p. 54).

Where visible, the bottoms of the upper cabinets would be masked by solid butternut panels screwed to the plywood. Otherwise, bottom and top edges would be finished with the same beveled trim as that used for the base cabinets. Drawer fronts, door frames, upper-cabinet backs that would be visible through glass-panel doors, and the door panels in the base cabinets would also be butternut.

Of course, kitchen cabinets should be functional as well as attractive. These cabinets would be fitted with such amenities as roll-out

Cabinet construction



Drawing: Bob Goodfellow

shelves, a shop-built lazy Susan, display shelves (complete with four hand-dovetailed drawers attached to the underside of one of the shelves), and homemade ceramic knobs and tiles made by Dottie and Glen in their basement shop.

Layout—My first step in building the cabinets was to mark all the pertinent features of the kitchen (including the locations of windows, wall openings and electrical outlets) on story poles (wood sticks cut to the length of each run of cabinets). The Williams' house is a 1½-hour drive from my shop, and the story poles guaranteed accurate measurements. That done, I returned to my shop and made construction drawings for each cabinet. I also mapped out on paper the best way to cut each 4x8 sheet of plywood to minimize waste. Then I produced a cutting list of all the cabinet parts.

With the cutting list completed, I ordered the butternut from L. L. Johnson Lumber Manufacturing Co. in Charlotte, Michigan. The butternut—kiln-dried, surfaced to a thickness of ¾ in. and delivered—cost just 98¢/bd. ft.

Solid-wood end panels—Construction began Krenovian style: slowly. I started by rummaging through 1,000 bd. ft. of random-width butternut in my shop to select the best stock for the end panels. Then I squared the edges of the panel stock on my 6-in. jointer-planer and removed the knife marks using a 22-in. long homemade jointer plane. This took just one swipe with the plane and produced the optimal surface for gluing. I glued up the panels with yellow glue and scraped off the excess before it hardened.

With the glueup completed, I flattened both sides of the panels by planing them *across* the grain using a #4 Stanley smoothing plane, then *with* the grain using a #3 Stanley smoothing plane. I could have flattened the panels using a belt sander, but I prefer the satisfying sensation of hand-planing to lunching on sawdust. Besides, it takes about the same amount of time either way. Both planes worked best with their irons ground to a 22½° angle.

I finished the job using a Japanese smoothing plane and a Stanley #80 cabinet scraper that had a slightly burred edge. I like Japanese planes because their exceptionally hard cutting edges produce a glasslike sheen. The cabinet scraper was handy for smoothing knots and unruly grain, and with no tearout.

After a final polishing with 600-grit sandpaper, I cut the panels to size and grooved the base-cabinet panels to accept the tongues on the plywood tops and bottoms.

Lower carcase construction—The plywood parts for the base carcases were assembled with yellow glue and 1-in. pneumatic staples. The T&G joints holding the butternut end panels to the tops and bottoms of the carcases were glued only along a 1-in. long section at the fronts of the cabinets, helping to hold the panels to the carcases while allowing the butternut to expand and contract. After the glue cured, I glued and stapled ¼-in. birch plywood to the backs of the carcases, fitting it into rabbets cut into the butternut end panels.

In retrospect, I'm not convinced that a 1-in. glue line in the front and a glued and stapled back is the best way to secure a solid-wood end panel to a plywood carcase. Seasonal movement of the panel *could* eventually break the glue lines and loosen the staples, especially if the panel is made of wood that's less stable than butternut (after a year in service, there is no sign of problems with these cabinets). That's why I now build most of my base carcases completely out of plywood, then screw solid-wood panels to the visible plywood ends. Installed from inside the cabinets, the screws

A simple tenoning jig

The stiles and rails on the cabinet doors are coupled with bridle joints. Cutting these joints was easy, using a table saw and a tenoning jig. A woodworking friend and I built a simple jig for this job over a weekend, using wood scraps and simple hardware. Like commercial jigs, this one is guided by the miter-gauge slot in a table saw. I positioned the saw's standard rip fence to shield my right hand from the sawblade, but that isn't required. The only hitch I encountered was in cutting the 4-in. long bottom tenons on the stiles. My table saw will cut a maximum 3 in. deep, so I cut the top 1 in. of the tenons by lowering the sawblade, laying the stiles flat on the saw table and using the saw's miter gauge to guide repetitive cuts in the stiles up to the shoulders of the tenons. —*R. A.*

The author's shop-made tenoning jig.

Cutting a tenon.

A completed bridle joint.

pass through oversize holes in the plywood to allow the panels to expand and contract.

The exposed plywood edges of each carcase were trimmed with iron-on white birch veneer. A variety of these easy-to-apply veneers is available from most cabinet- and furniture-shop suppliers. I buy mine, plus all my cabinet hardware, from two reliable distributors; Superior Distributing Co., Inc. (918 Ft. Wayne Ave., Indianapolis, Ind. 46202; 800-622-4462); and Courterco (8098 Woodland Dr., Indianapolis, Ind. 46278; 800-626-2373).

Doweling the uppers—The interiors of the upper cabinets adjacent to the living room would be clearly visible through their glass doors, so I selected A-2 birch plywood for the tops and bottoms with a heartwood face veneer that closely matches the color of butternut. I used a homemade doweling jig to align the dowel holes in the tops and bottoms with those in the sides. This simple jig (as described in Krenov's *The Fine Art of Cabinetmaking)* is simply a length of 1x1 hard maple with a heel on one end and 5/16-in. holes drilled through it, spaced 1 in. o. c. The heel allowed the jig to be hooked to the front edge of each board, and a pair of drywall screws held the jig temporarily in place at the ends of the boards during drilling. I drilled the dowel holes using a brad-point drill bit fitted with a wood step to prevent the bit from running too deep.

Before assembling the upper cabinets, I drilled holes in the cabinet sides to accept brass-plated shelf clips (Knape & Vogt, 2700 Oak Industrial Dr., N. E., Grand Rapids, Mich. 49505; 800-253-1561) and located the holes with the aid of another hole jig. These clips would support 1/4-in. thick plate-glass shelves.

When assembling the carcases, I tapped 5/16-in. by 2-in. fluted dowels into the holes, allowing each dowel to stick out exactly 1/2 inch. If you've ever tried to set a bunch of dowels at the same height, you know how exasperating that can be. I did it by drilling a 3/8-in. dia. hole clear through a 1/2-in. thick piece of wood, slipping this jig over each dowel as I drove it home. With glue in the holes of the carcase sides, I pressed the carcases together and pulled the joints tight with pipe clamps.

Finally, I ironed white-birch veneer onto the plywood edges, saw that the veneer's color clashed with the plywood, and ironed it off. I replaced it with a 3/16-in. thick strip of solid butternut, adhered with yellow glue and routed flush using a trim bit guided by a ball-bearing.

Stiles into rails—Photographs of Krenov's Swedish ash and solid pearwood cabinets persuaded me to try a sort of reverse door style: that is, stiles butting into rails that are 1/8 in. thicker than the stiles to produce & shadow line (right photo, facing page). For stability, I made the parts from straight-grained, quarter-sawn wood, cutting the rails for adjacent doors out of a continuous length of butternut so that the grain pattern would flow from one door to the next. The stiles and rails were joined with exposed bridle joints (see sidebar, facing page).

To house the door panels, I cut slots along the inside edges of the stiles and rails, stopping each cut before reaching the ends of the stiles so they wouldn't show. I cut the door panels from flat-sawn stock for maximum figure. At first, I thought 1/4-in. thick door panels would do. But I discovered that raising the panels flush with the stiles looked better. Extra-wide panels, as well as panels for double doors, were glued up out of a single piece of butternut for consistent figure. All the panels were sized and raised on the table saw.

The glass-panel doors were built like the others, except they were fitted with a center mullion mortised to the top and bottom rails. The 45° bevels on the front edges of the mullions were cut using the table saw, then smoothed with a 6-in. homemade polishing plane. All the door parts were hand-planed and dry-fitted before the doors were assembled.

The doors were drilled after glue up to receive 125° Grass concealed hinges (Grass America, Inc., P. O. Box 1019, 1202 Highway 66 South, Kernersville, N. C. 27284; 800-334-3512). I wanted to install 176° hinges, which allow doors to swing completely out of the way when opened, but Dottie thought they looked too bulky. When hanging the doors, I hand-planed the edges where necessary to produce a 3/32-in. gap between the doors and moldings to allow for expansion.

Dovetailed drawers, roll-out shelves—The base-cabinet drawers are made of hard maple that was hand-planed, scraped and polished with 600-grit sandpaper. I dovetailed the corners using a router and a dovetail bit in combination with a Stanley dovetail jig. Grooves accept 1/4-in. birch plywood drawer bottoms, which were secured to the drawer backs with staples. Before assembly, I rounded over the top inside edges of the drawer sides using a 1/4-in. roundover cutter on my shaper, adding a nice visual detail while making the drawers more user-friendly. The finished drawer fronts were cut from 5-in. wide by 8-ft. long butternut stock (to produce a continuous grain pattern), temporarily attached to the drawers with double-stick carpet tape and then fastened permanently from inside the drawers with countersunk drywall screws.

The drawers glide on side-mount, Blum 230E self-closing drawer slides (Julius Blum, Inc., Highway 16-Lowesville, Stanley, N. C. 28164; 704-827-1345). I like these slides because they're easy to install, durable and they operate smoothly. They handle up to 88 lb. per drawer. Though full-extension slides would have provided an extra 3 in. to 5 in. of throw, the clients didn't want to spend an extra $15 to $20 per drawer for them.

Roll-out shelves in the base cabinets are basically 3-in. deep drawers located at the bottoms and midpoints of the cases. They're constructed and supported like the rest of the drawers (but without the butternut fronts).

Bending in the shower—There's only one jog in the kitchen cabinets, and that's in the

Craftsmanship on display. **Behind the stove (top photo), a solid butternut cabinet displays ornamental ceramics. Its delicate, hand-dovetailed and hand-planed drawers (photo above) hold coffee, teas and dried foods.**

Shop-built carousels. **The lazy Susan consists of two plywood carousels that rotate independently on 12-in. bearings. The maple edge banding for the carousels was steam-bent in the author's shower and is reinforced with iron-on oak veneer. Each carousel is held in the closed position by a simple bullet catch (visible on the top shelf, right).**

southeast corner of the kitchen. This called for the installation of a lazy Susan to render the corner storage space accessible. Concealed behind a pair of hinged doors, the lazy Susan consists of two 34-in. dia. plywood carousels, each revolving independently on a 12-in. bearing supported by a plywood shelf (bottom photo, previous page). Each bearing supports up to 1,000 lb.; I bought them from Armac Distributing Co. (219 Main St., Garden City, Mo. 64747; 816-862-8600). The carousels and shelves are made of ¾-in. birch plywood, edge-banded with strips of hard maple.

The tight radius of the carousels required that I steam-bend their maple edgings before glue up. I accomplished this by using my shower as a steam box. Twenty minutes of exposure to steam left the edgings pliable enough to bend into a tight circle, and I joined the ends temporarily with spring clamps. When the strips were dry, I undamped them and attached them to the carousel edges with yellow glue and ½-in. brads. Finally, to reinforce the edgings, I applied iron-on oak veneer over them. This added another grain direction to help prevent splitting.

I also installed a pair of bullet catches (made by Knape & Vogt) to hold the carousels in the closed position. A bullet catch is a small spring-loaded cylinder with a steel ball partially projecting from one end; the ball engages a strike plate. The cylinders are mounted in deep holes in the tops of the plywood shelves, and the strike plates are screwed to the undersides of the carousels.

Dovetails on display—Glen and Dottie wanted a place for displaying pottery, so I built a solid butternut wall-mounted display cabinet (top and center photos, previous page) consisting of a coffee-cup rack and a stack of shelves grooved to hold ornamental dinner plates. Because the stove and microwave would be nearby, I added a series of small, hand-dovetailed drawers for holding coffee, tea and other dried goods.

The cabinet was assembled with dowels, same as the upper cabinets. The dovetailed drawers have ½-in. thick fronts, backs and sides, and ¼-in. thick solid butternut bottoms. Once I glued up the drawers, I hand-planed them for a friction fit, using paraffin and air as the drawer glides.

Trim and tops—The only parts left to make were the plywood bases, the solid butternut toe kicks, the beveled moldings for the tops and bottoms of the cabinets, and the countertops. The molding is made of 1x5 stock with a 30° bevel on the front edge, rounded over using a router and a ⅛-in. roundover bit. The base molding is affixed with drywall screws to the tops of the toe kicks and to the undersides of the base cabinets. The upper moldings are screwed to the plywood tops and bottoms.

The countertops have plastic laminate surfaces and a butternut nosing, which was fastened with 1-in. brads and yellow glue.

My favorite portion of the countertop is next to the stove. That's where I inlaid a square section of Glen and Dottle's homemade tiles to serve as a built-in hot plate for pots and pans. Made out of a low-fire white clay, the tiles were formed in a wood mold fitted with a CDX-plywood bottom to produce a wood-grain imprint on the tiles. The sandpebble coloring of the tiles was achieved by applying three coats of a commercial glaze before firing.

Finish and installation—Unfinished, lightly oiled or waxed surfaces are Krenov's favorite, but I was hesitant to use any of them in a kitchen. Instead, I applied two thinned coats of Minwax Helmsman Spar Urethane (The Minwax Co. Inc., Montvale, N. J. 07645; 201-391-0253), polishing between coats with 600-grit paper and buffing the final coat with beeswax. This protected the surfaces and produced the satin sheen I was striving for.

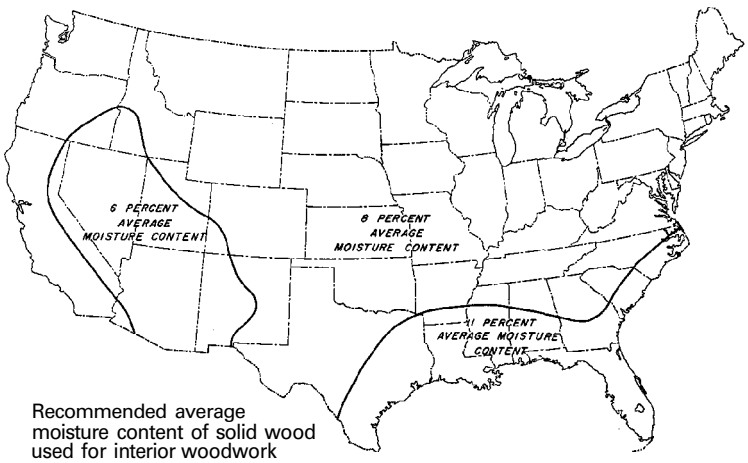
The interior surfaces were finished with two coats of Hydrocote sanding sealer and four coats of Hydrocote satin lacquer (The Hydrocote Co., Inc., E. Brunswick, N. J. 08816; 800-229-4937). Hydrocote is a water-base finish that's extremely durable and waterproof. I sanded between coats with 400-grit wet/dry sandpaper. I also sprayed the drawers and roll-out shelves with a six-coat Hydrocote finish, allowing it to cure for 12 hours before polishing it with 4/0 steel wool and Hydrocote rubbing compound. Finally, I installed all the door and drawer knobs, made by Dottie out of the same clay and glazing as that used for the tiles. □

Rex Alexander is a custom woodworker in Brethren, Mich. Photos by Bruce Greenlaw.

Solid wood and humidity

Most kitchen-cabinet carcases are made of plywood or particleboard, both of which are significantly more dimensionally stable than solid wood. In northern Michigan's climate, for instance, an unfinished 12-in. wide Douglas fir plywood panel will typically expand and contract about 1/100 in. as it responds to seasonal changes in relative humidity; a solid, unfinished flatsawn Douglas fir panel of the same size will expand and contract about 3/16 inch in width. That's why using solid wood for kitchen-cabinet carcases, especially where it will be attached to plywood or particleboard, can be risky. If you plan to use solid wood for carcase construction, here are a few pointers to keep in mind.

Quartersawn wood, which has its annual rings perpendicular to the face, is more stable than plainsawn wood, which is milled with its annual rings roughly parallel to the face (for more on quartersawn and plainsawn wood, see *FHB* #58, p. 41).



Recommended average moisture content of solid wood used for interior woodwork

Before it's converted into cabinet parts, wood should be dried to a moisture content (MC) consistent with the average indoor relative humidity of its final destination (see map above), or about 8% MC in northern Michigan. Relative humidity is the ratio of the amount of water vapor in the air, at a particular temperature, to the maximum amount the air can hold at that temperature, expressed as a percentage. It determines the moisture content of wood, which in turn determines the final dimensions of the wood (below a moisture content of about 28%, wood shrinks as it dries). Moisture content can be determined by the use of a moisture meter—available from most woodworking-tool suppliers.

Seasonal movement of solid wood can be curbed substantially by applying multiple coats of a wood finish to all sides. This protects the wood from extremes in humidity, substantially reducing seasonal expansion and contraction. It also prevents the wood from warping, which is caused by uneven moisture absorption.

Different wood species can vary significantly in their response to seasonal changes in relative humidity. For example, a 12-in. wide panel of unfinished quartersawn white oak in northern Michigan will shrink about .13 inch in width from summer to winter, while the same panel made of quartersawn butternut will shrink about .08 inch.

By far, the best book I've read on the characteristics of wood is *Understanding Wood: A craftsman's guide to wood technology,* by R. Bruce Hoadley (The Taunton Press, Inc.). It has all the charts, graphs and formulas you need, and it's written in layman's terms. Also, your local weather bureau can give you statistics on local humidity.

***—Bruce Greenlaw, associate editor of* Fine Homebuilding.**

Map courtesy of Forest Products Laboratory